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MOMORDICA CYMBALARIA A NUTRITIOUS UNDERUTILIZED VEGETABLE TAXONOMY, NUTRITIONAL, MEDICINAL, PROPAGATION, HYBRIDIZATION AND CYTOLOGICAL ASPECTS

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ABSTRACT

Karchikai S. N.*Momordica cymbalaria* belongs to the family cucurbitacae. It is considered as underutilized vegetable crop as it is not commercially cultivated because of lack of planting materials. It is a rich source of Vitamin C, Fibre& Beta carotene and also rich in Iron & Calcium content. It is having medicinal properties such as Antidiarrhoel, Hepatoprotective, Antidiabetic ,Nephroprotective, Antiallergic, Antimicrobial etc. Not only are the fruits, all parts of plant having medicinal properties. In this review a focus on Propogation, Taxonomy, Nutritional aspects, Medicinal value, Floral Biology, Karyotype analysis & Hybridisation aspects are covered. Special breeding methods have to be used in future for converting this crop into commercial cultivated crop.

KEYWORDS: A17 KDaprotein, Antidiarrhoel, Antimicrobial, Cardiacglycosides, Hepatoprotective,Nephroprotective, M.cy Protein, Saponins, Tubers, Vitamin C

INTRODUCTION

India is the second largest in vegetable production in the world after china. APEDA. As per ICMR recommendation vegetable consumption is 280g/day, but it is only 135g/day**.** (Kalloo, 1998).This gap is due to load on production of conventional foods. To overcome this it is essential to explore the available underutilized vegetables. These underutilsed vegetables are far superior nutritionally and have medicinal properties along with high yield potential. Some of these crops are resistant to biotic and abiotic stresses. The name itself indicates that these crops are less utilized. The reason for this is these are generally region and season specific. Fifteen vegetables have been documented as underutilized in Northern Karnataka which includes *Momordicacymbalaria*.(karchikai),also.(Kulkarni 2003).

Karchikaibelongs to the family Cucurbitaceae and is commonly known as melons, gourds or cucurbits and includes crops like cucumbers, squashes (including pumpkins), luffas, melons (including watermelons). The family is predominantly distributed around the tropics, where those with edible fruits were amongst the earliest cultivated plants in both the old and new world.Momordica is one among the different genera of cucurbitacae which includes 47 species. This is one of the most genetically diverse groups of food plants in the plant kingdom. The plants belonging to this family are frost-sensitive, drought tolerant, and intolerant to wet and poorly drained soils. These are used as vegetables and also having high nutraceutical values. Production of cucurbits seems to have increased over the time due to high demand and consumer awareness on the health benefits of cucurbit fruits.

The plant is a perennial climber available only during the Kharif& Rabi season and is found in the south Indian states of Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, and Tamil Nadu. In Karnataka it is known by the name Karchikai, in Tamil as Athalakai, in Telugu as Kasarakai and in Marathi as Kadavanchi(Anon 1962).The crop is not cultivated by the farmer as a regular crop, eventhough it comes very well during Kharif and Rabi season mainly in the black soils where sorghum, Bengal gram and onion can be cultivated. Initially it was considered as a weed, but the tubers were used for medicinal purpose, from ancient times.Recently because of the nutritional value of the fruits, it is used as vegetable. It is reported as medicinal plant in India and various parts of plant are useful for treating the common ailments. Not only the fruits even leaves can also be used as a leafy vegetable(Kirtikar&Basu 1993).Because of lack of awareness about the nutritional aspects, it is not commercially cultivated. Hence it is considered as anunderutilized vegetable crop.

TAXONOMY & FLORAL BIOLOGY

It belongs to the kingdom Plantae, Class Dicotyledonous; order Cucurbitales, Family Cucurbitacae, GenusMomordica& Species Cymbalaraia Hoof.The synonyms are *MomordicatuberosaRoxb*., or *LuffatuberosaRoxb.* The plant is a climbing annual or perennial herb with slender, scandent, branched, striate stem. It is a trailing plant with large turnip shaped tuberous rootstock, flowers are white to yellow in colour. The seeds are 4.6 mm long, ovoid shaped, Black, smooth and shiny. It is a cross pollinated crop.Flowers are small, unisexual in nature. The male flower peduncle is 5-30 mm long, filiform, puberulaus, ebracteate with 2-5 flowers in racemes with a pale yellow corolla and two stamens for each flower. The female flower is solitary on a peduncle of 28 mm length (Figure 1).The roots are woody, tuberous and perennial

PROPOGATION

The mode of propogation is through asexual method as it is generally propagated through tuberous roots.The tubers sprouts after the onset of monsoon and undergoes dormancy during summer dry periods. Seeds are black in color, shiny and are hard, so generally seeds are not used for propagation, because the rate of germination is very less or negligible. Tissue culture techniques can be useful for mass propagation by using different explants. Studies have also been conducted for this purpose and they have achieved a success. (Aileni et.al &Nikam et.al 2009).

NUTRITIONAL COMPOSITION

The crop is valued for its edible fruits, and leaves as vegetable and its tubers are mainly preferred for medicinal purpose.karchikaicontained higher amounts of carbohydrate (3.72%), protein (3.26%) fat (1.61%), fiber (5.63%) and ash (1.25%). The beta-carotene content of karchikaiwas 224.9 Ig/100 g and that of sponge gourd and ridge gourd was 200 I.U/100 g and 55 I.U/100 g respectively. Karchikaicontained a higher amount ofascorbicacid160.77mg/100 g on a fresh weight basis. The iron and phosphorous content of karchikaiwas also found to be higher (130.00 mg and 5.50 mg/100 g, respectively) compared to other species**.**(Gopalanet al 1993)

The nutrient contents of Fruits of the two vegetables M.cymbalaria(Karchikai) and Momordicacharantia(Bittergourd) are compared. The calcium content of Karchikai is three times higher than that of the Bitter gourd. The higher concentration of this nutrient in Karchikai may be exploited and used. The ascorbic acid (Vitamin C) content of Karchikai is two times higher than that of Bitter gourd. It is used to meet the shortage of vitamin C consumption. The content of potassium in Karchikai is also two times higher than in bitter gourd.(Gopalan et al 1994.)

Not only the fruits, the tubers and leaves of this crop are also used for therapeutic uses as these contain flavonoids, steroids, Tri terpenes, Saponins(PramodKumar etal 2010) . Tubers have been reported to contain sterols, Triterpenes, Cardiac glycosides, and Saponins**.**(Fernandes et al2007).This crop can act as a weapon against malnutrition & hunger.

MEDICINAL VALUE/ THERAPEUTIC USES

Pharmaceutical studies conducted by various scientists reported that Fruits, Leaves & Tubers are useful for treatment of various diseases. It is a crop in which all parts of a plant are important. Earlier only tubers were used for treatment purpose; recently many scientists reported the application of fruits and leaves for treating various diseases.

FRUITS

Fruits are the economic part of this crop.(Figure 2)Fruits are green in color and these are used as vegetables. According to the studies conducted by various scientists the fruit of this plant has been reported to possess Hypoglycaemic, Hypolipidemic, Cardio protective, Hepatoprotective(Koneri et al 2008),Nephroprotective(Kumar et al 2011)and Antidiarrhoel properties. (Swamy et al 2008).The presence of Saponinis the responsible forHepatoprotective, Antioxidant and Anticancer Properties reported by Patel et al. 2014**.**Antimicrobial activity was also reported byKulkarni et al. 1992.

Fruits are also used in treating several disorders such as, rheumatism, sub acute cases of spleen and liver disease. The fruit juice is also used forthe treatment of malaria, wounds, worms, and parasites. Rao et.al 2001 reported that fruits possessantidiabetic and hypoglycaemic activity. It is also reported thatalcoholic extract of fruits has significantly reduced the serum glucose level in both normal and type II diabetic rats.(Kumar et.al 2010)

A17KDa protein with an iso electric point of 5.0 was identified as the active principle of antidiabetic activitypresent in fruit extract which is named as M.cy protein. The fruits have also reported to have cardioprotective effect. Koneri et al 2008 reported that M.cymbalaria powder 500mg/kg of body weight prevented the alterations in Myofilamental alteration such as Myocytosis and Myofibrillar degeneration in rats.

LEAVES

Along with the fruits leaves can also be used as a leafy vegetable(Figure 3). Because of its bitter taste, generally it is not preferred as leafy vegetable. It is useful in treating thediabetic patients, with 1 spoon of dried leaves powder daily morning along with water. It has also recorded that, after 15 days of consumption, there is reduction in blood sugar level in diabetic patients.Leaf Tea is used for malaria, wounds, worms, parasites, fever etc.(Fernandes et al.2007 &Osinubi et al 2008).

Ramanath B & Amar Kour2012studied the phytochemical and anti-microbial activity of the leaf extracts by different methods. He concluded that the leaves of m.cym have potent activity against all set of microorganisms. Results support the popular use of this plant for treating minor ailments, wounds, fever etc. Methanol extract of aerial parts of *Momordicacymbalaria*(200mg/kg of body weight) has showed significant anti cancer activity as compared to standard cyclophosphamide against ehrlich ascites carcinoma induced cancer in mice.(Jeevanatham 2011).

TUBERS

Tubers were having medicinal properties (Figure 4). These have been in use since from ancient times for curing many ailments such as wounds, diarrhea, Stomach ache & Mouth ulcers. Recent studies proved that tubers are useful for

the extraction of the Sterols, Triterpenes, Saponins, carbohydrates etc.which are the important secondary metabolites(Kumar et al 2010 &Fernandes et al 2007). Kumar et.al 2011reportedNephroprotective activity and Hepatoprotective activity (of ethanolic extract of tubers) in rats by Koneri 2011. Tubers also have anti-implantation activity. (Koneri et al 2007). Ethanolic extract of roots of *Momordicacymbalaria* have anti-ovulatory (Koneri et al 2006) and abortifacient activity in rats i.e ovulation was inhibited.Antidiarhoel activity was reported by Swamy et al 2008.

CYTOLOGICAL STUDIES

According to theKaryotype analysisby L.K Bharati et.al. 2011,it is confirmed thatthe number of chromosomes is 2n= 18, earlier it was reported as 2n=16,22. The Karyotype analysis revealed significant differences among the chromosomes of *Momordicacymbalaria* and its other relatedspecies. It was reported that chromosomes of this crop can be easily distinguished from other species.The meiotic studies atdiakinesis/metaphase-I stage also showed 2*n* = 9II in *M. cymbalaria*The mean chromosome length is 2.62 μm and there are 2 secondary constricted chromosomes.

HYBRIDIZATION

Attempts have been made to cross *Momordicacymbalaria* with its related species**,** such as Spine gourd,Bittergourd& Sweet gourd. Interspecific crosses are also made among the different species of cucurbits including Bitter gourd and Spinegourd . Among these crosses seeds are set in other crops except in this crop. About 50 interspecific crosses were attempted, but there is no seed set in cymbalaria.Till today studies are lacking with respect to hybridization, because of crossability barriers, non-availability of Planting materials, very low seed set or seeds are non viable. The only method to propogate is through tubers . Studies regarding Seed viability or Seed Dormany are also lacking.L.K Bharati et.al. 2011.

MICROPROPOGATION

To overcome the invitropropogation of *Momordicacymbalaria* was reported by Ailenia et.al &Nikamet.al.2009**.**Leaf tip, Stem, nodal segments, is used as explants for the InvitroPropogation. Success was achieved using nodal explants.Maximum number of indirect regeneration of multiple shoots (9.0 +_ 0.5) was achieved from leaf explants on MS medium. Large scale shoot formation (35+- 3.4) shoots/explants was achieved by repeated subculturing of leaf callus on shoot regeneration medium. Root induction was achieved on harmone free half strength MS medium. Eventhough success was achieved with respect to invitropropogation but in earlier reports there was a low proliferation rate. To overcome this problem, Balkhande S.V et.al 2013studied the influence of Agno3 Silver nitrate that enhances the regeneration capacity in many plants.The nodal explants were cultured on M& S medium containing BAP, Kinetn and AgNO3, for shoot bud formation and also their subsequent proliferation. Multiple shoots were formed with BAP and AgNO3 composition. An average of 14.30+- 0.34 shoots per explant were obtained after 4 weeks of culture. The number of shoots increased three fold times, in medium containing AgNO3.

FUTURE APPROACH

Despite its high medicinal value and nutritionally rich, it is not being cultivated commercially.Because of lack of seeds/ tubers. Studies are lacking with respect to seed Dormancy, Seed viability test. Different seed germination and seed viability tests have to be conducted for recommending the crop for commercial cultivation. It is already proved by different scientists that it can be used for curing so many diseases, so to exploit the potentiality of this crop it has to be

grown on large scale. Since the seeds are non-viable/ less germination frequency it's difficult to grow on large scale. So now it is essential to study this crop and identify breeding methods suitable for the improvement of this crop. To exploit its potentiality special breeding methods can be used such as protoplast fusion, embryo rescue and embryo cultureto overcome post fertilization barriers. The germplasm of different locations has to be characterized by using different markers to assess variability and also for desirable traits.

CONCLUSIONS

Momordica cymbalaria is a crop found in tropical india it is not commercialized because of lack of seeds or tubers availability in market. Since seeds are poor in germination it has to be grown by tubers. Experiments by Balkhande S.V et.al 2013reported that multiplication by tissue culture is possible. As it also considered as a medicinal crop because of its medicinal properties, this crop can be genetically manipulated to exploit its potentiality.Further studies need to be conducted as mentioned in future approach.

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APPENDICES

Figure 1: Male & Female Flowers of *Momordica cymbalaria*

Figure 2: Fruits of *Momordica cymbalaria*

Figure 3: Tubers of *Momordica cymbal aria*

Figure 4: Leaves of *Momordica Cymbalaria*